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Keeping more of the LED Supply Chain in the US- An Equipment Manufacturer's Perspective

An Informal Survey

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Outline

- Informal Survey of a number of equipment manufacturers
  - Have current DOE projects
  - Have been involved in Compound Semiconductor
- The Trend in IP Intensive Industries in the US
- What other countries are doing
- Recommendations

The Survey

- Applied Materials
- KLA-Tencor
- Oxford Instruments
- SEMI
- UltraTech
- Veeco

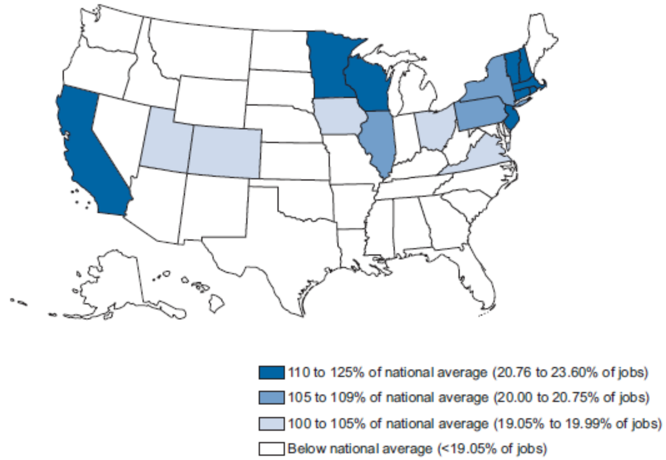
"What are the factors that cause manufacturing to exit the US, and what can be done to stop the exodus?"

Intellectual Property and the US Economy: Industries in Focus – US Department of Commerce

Table 1. Patent Intensity, FY 2004-08

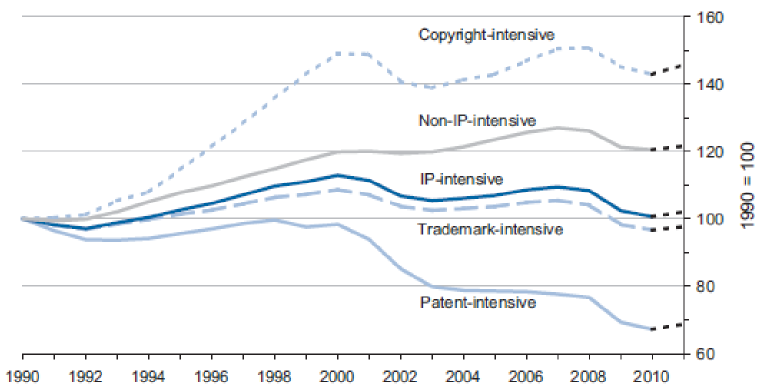
	NAICS code	Industry title	Patents (number)	Employment (1000 jobs)	Patent intensity (patents/ 1000 jobs)
Above mean	3341	Computer and peripheral equipment	54,416	196.1	277.5
	3342	Communications equipment	35,797	135.2	264.8
	3344	Semiconductor and other electronic components	50,088	448.7	111.6
	3343,-6	Other computer and electronic products	7,744	71.4	108.5
	3345	Navigational, measuring, electromedical, and control instruments	42,415	441.3	96.1
	3251	Basic chemicals	12,109	150.9	80.2
	335	Electrical equipment, appliance, and components	23,503	433.0	54.3
	3254	Pharmaceutical and medicines	13,627	291.3	46.8
	3399	Other miscellaneous	12,717	339.2	37.5
	3253,-5,-6,-9	Other chemical products and preparation	10,322	318.1	32.4
	3391	Medical equipment and supplies	9,716	303.2	32.0
	333	Machinery	37,105	1,173.7	31.6
	3252	Resin, synthetic rubber, fibers, and filaments	2,771	106.4	26.0
	326	Plastics and rubber products	8,289	775.8	10.7
	3361-3363	Motor vehicles, trailers and parts	8,298	1,029.8	8.1
	327	Nonmetallic mineral products	3,651	497.2	7.3
	3365,-6,-9	Other transportation equipment	1,585	222.4	7.1
	3364	Aerospace products and parts	2,726	473.3	5.8

Map 1. IP-Intensive Industries' Share of Covered Employment by State, 2010



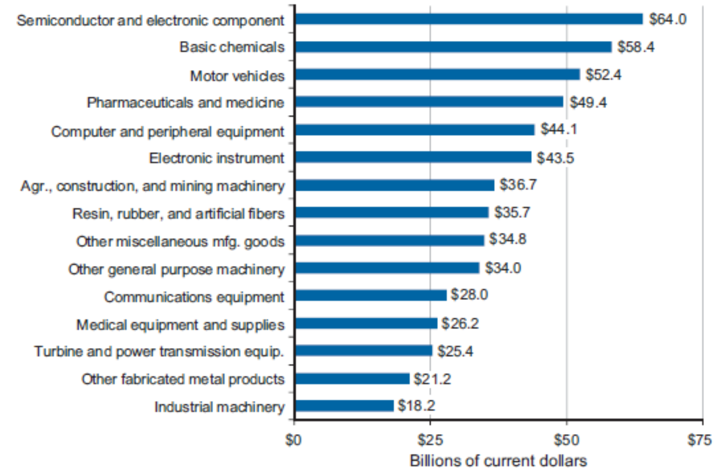
Source: ESA calculations using data from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages.

Figure 2. Indexed Employment in IP-Intensive Industries, 1990-2011



Source: ESA calculations using data from the Bureau of Labor Statistics' Industry Productivity program.
Note: Black dotted lines represent ESA projections of 2011 employment growth based on data from the Bureau of Labor Statistics' Current Employment Statistics program.

Figure 9. Merchandise Exports of Selected IP-Intensive Industries, 2010

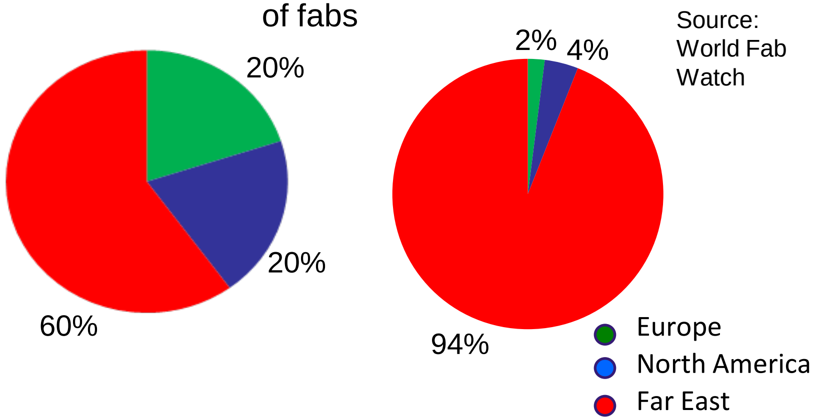


Source: ESA calculations using data from the Census Bureau's Foreign Trade Division.
Note: The selected industries accounted for 74 percent of merchandise exports of IP-intensive industries.

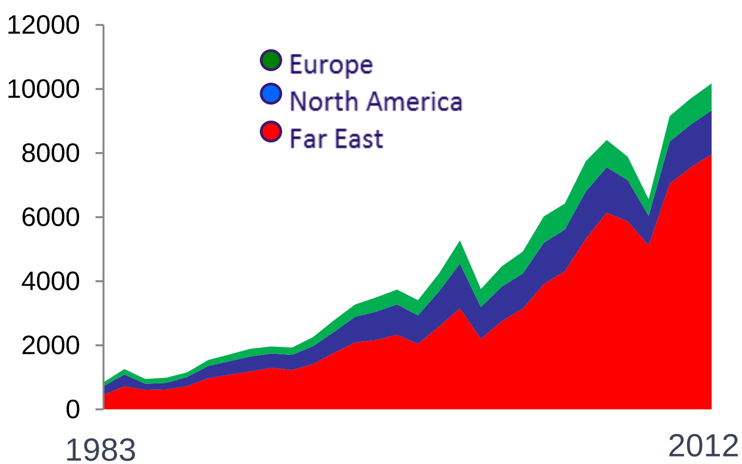
The Silicon Chip Fabrication Industry Already Migrated Overseas. Equipment Manufacturing Equipment Eroding

Semiconductor *Chip* Fabrication

2004 Regional distribution of fabs 2014

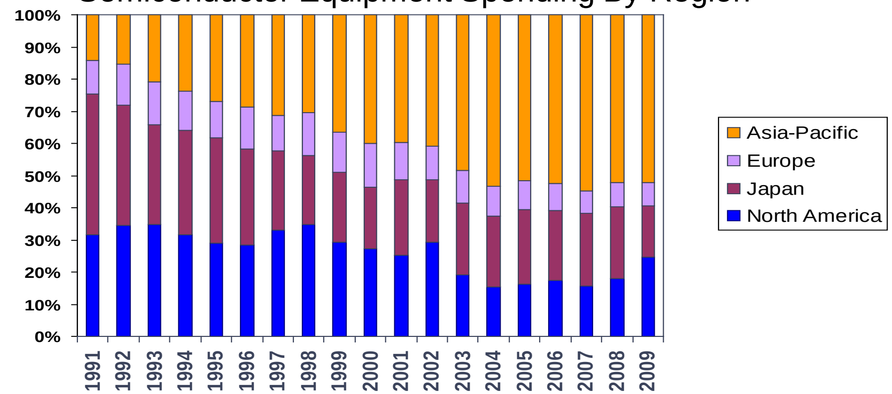


Silicon Wafers Shipped to End Market Regions

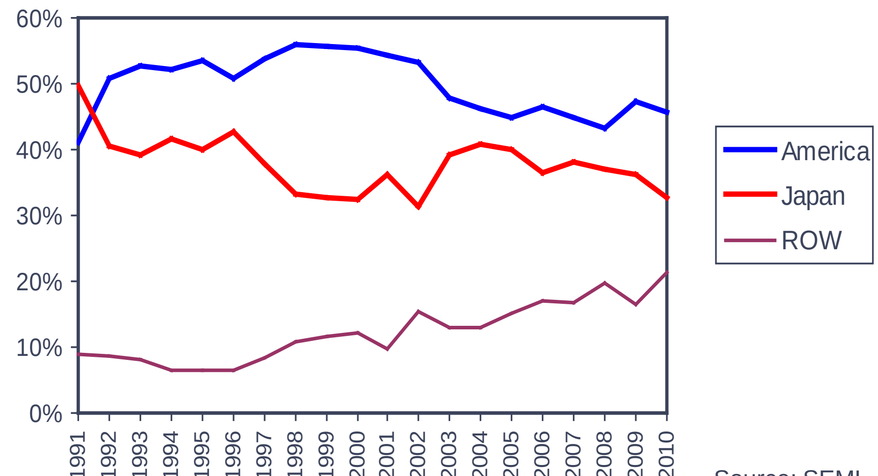


Semiconductor *Equipment* Manufacturing

Semiconductor Equipment Spending By Region



Equipment Sales by Producer Region



Source: SEMI

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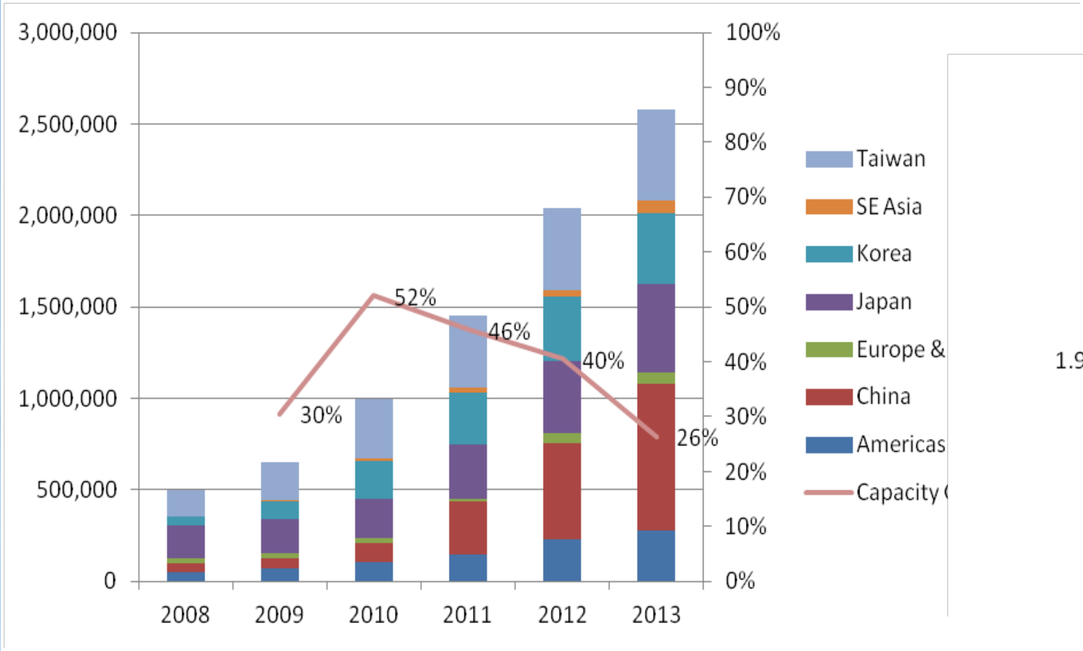
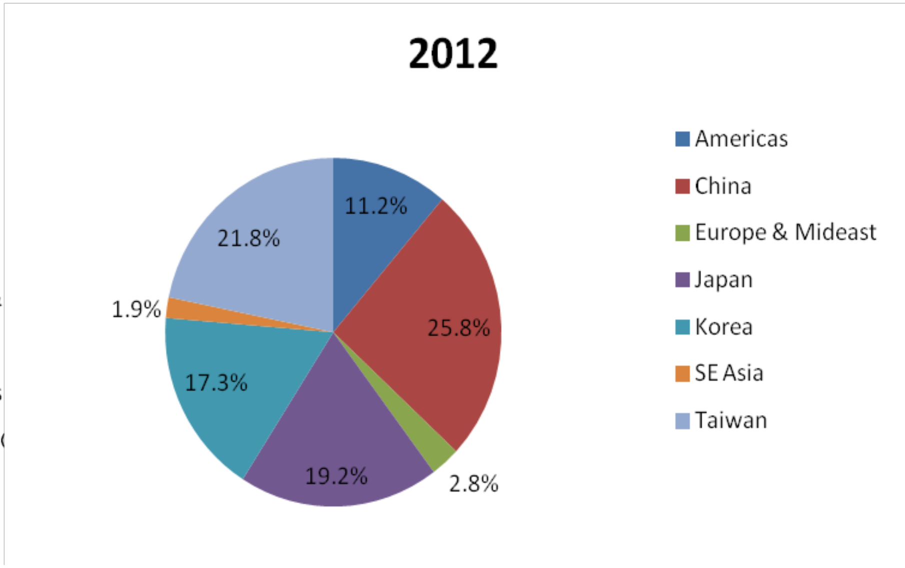
World LED Capacity by Region

LED Epitaxy capacity (4” equivalent per month)



Worldwide LED Epitaxy capacity to reach 2.03 M in 2012 (4” equivalent per month)



Source: SEMI Opto/LED Fab Forecast , April 2012

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China Domestic LED Development Roadmap

lm/W

200

150

100

50

Development Phase I
- Mid-Low End Epi Growth, Chip Production, LED Package
- Indicators, Displays & Signals

Development Phase II
- High Power Epi Growth, Chip Production, LED Package
- Street/Landscape Lighting, White LED Functional Lighting

Development Phase III
- Low Cost White LED; High Reliability Technology, Equipment & Application System Integration; Core IP
- Indoor & Outdoor White LED General Lighting

Tenth-Five
Develop White Light Technology

Eleventh-Five
Import 80% LEDs
Partial Local Sourcing

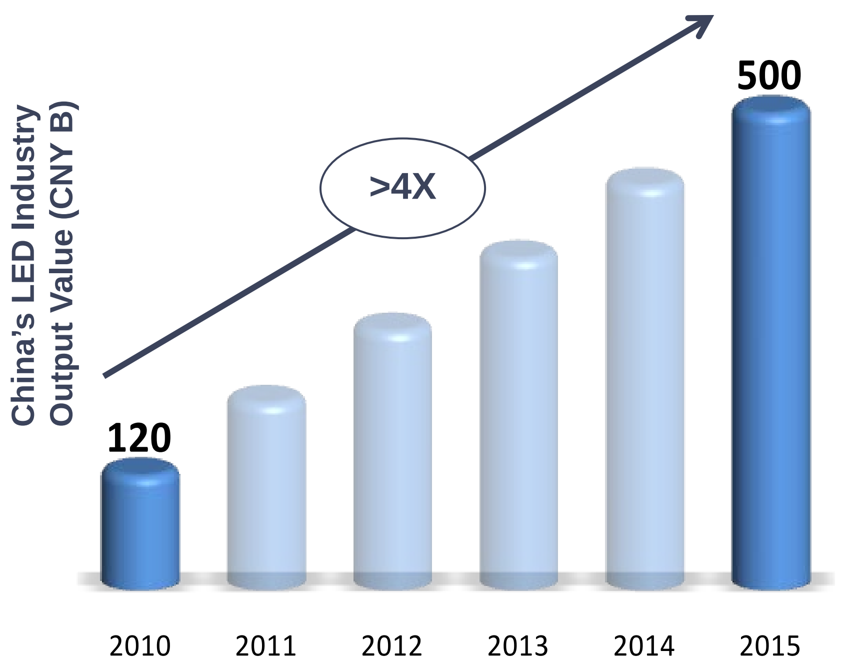
Twelfth-Five
Local Sourcing of LEDs & Components

Thirteenth-Five
All Local Sourcing (Equipment & Material)

2000 Initiation → **2005** Special Lighting → **2010** White LED Functional Lighting → **2015** High C/P White LED Lighting → **2020** Prevalence

Source: China Solid State Lighting Alliance, LEDinside, CLSA

China: 12th 5-Year Plan a Major Driver for Long-Term LED Market Growth



- Offer subsidies for LED Lighting
- Develop innovation LED lighting products and applications
- Establish national industry standards
- Drive LED adoption in China to 20%
- Increase LED industry output value by >4X by 2015

Expand domestic demand and stimulate LED lighting development

Creating a Domestic LED Supply Chain

Incentives Introduced to Produce LEDs in China

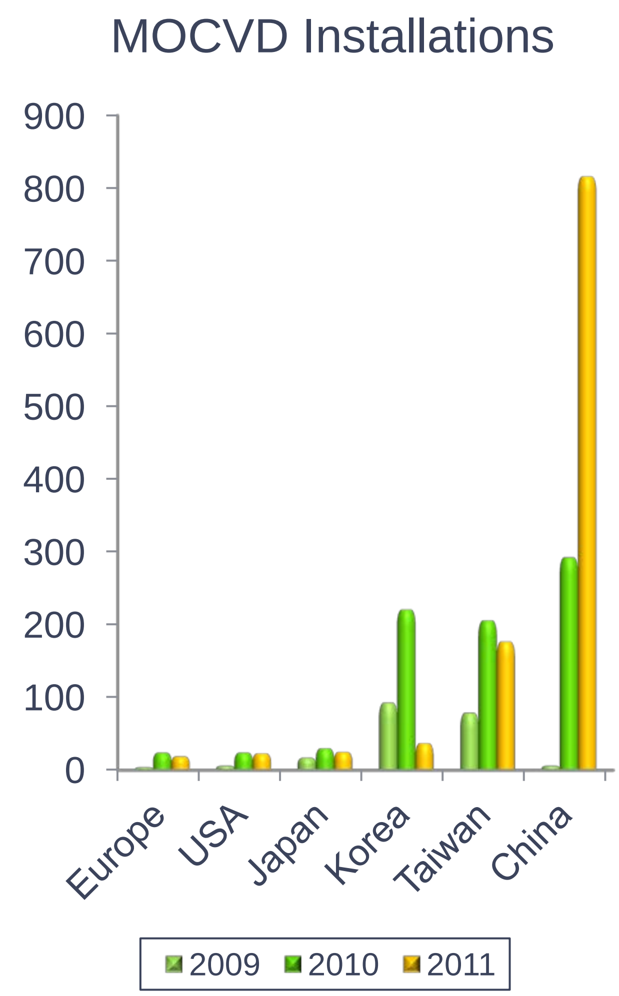
- Free Land
- Lower tax rates (15%) and accelerated depreciation
- MOCVD subsidy - $1.2M to $1.8M per reactor, expect **$1.6B** in total

Tax Incentives

- China:
  - Tax exclusion on new fabs for 10 years
  - 17% VAT on imported semiconductors
- Korea
  - Low interest rates and tax incentives for high-tech
  - Direct investment in education and R&D
- Taiwan
  - 5 year income tax holiday
  - No duty on imported manufacturing equipment

Equipment Landscape

- 80% to 90% of sales are to Asia
- Increasing content of tools is manufactured in Asia
- Supply chain is moving to Asia
- Customers want more “local” content



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Innovation

- To continue to sell manufacturing equipment – we must innovate to provide the best equipment
  - Equipment companies need a steady stream of new talent with STEM education
- Government support of LED specific equipment projects
  - Large equipment companies that serve the Si industry find it difficult to fund LED projects due to small market size
  - Long term multi-party collaborative development projects to encourage vertical collaboration from materials to end devices
  - Streamline FOA-Award process. One year is the life cycle for some products

Support

- DOE must provide more funding for the entire LED food chain by supporting development and manufacturing initiatives
  - Materials
  - Devices
  - Equipment
  - End use
- Tax incentives for manufacturing
- Tax incentives for R&D

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Thank You

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